1. v_{TH} , R_{TH} = ?

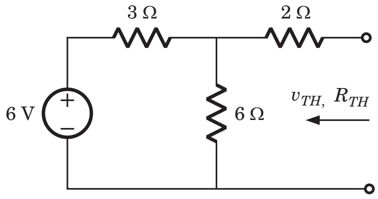


Fig. P.1.4.1

(A) 2 V, 4 Ω (B) 4 V, 4 Ω

(C) 4 V, 5 Ω (D) 2 V, 5 Ω

2. i_N , R_N = ?

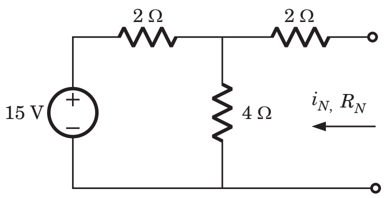


Fig. P.1.4.2

(A) 3 A, $\frac{10}{3}$ Ω (B) 10 A, 4 Ω

(C) 1,5 A, 6 Ω (D) 1.5 A, 4 Ω

3. v_{TH} , R_{TH} = ?

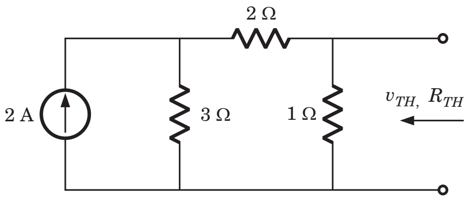


Fig. P.1.4.3

(A) –2 V, $\frac{6}{5}$ Ω (B) 2 V, $\frac{5}{6}$ Ω

(C) 1 V, $\frac{5}{6}$ Ω (D) –1 V, $\frac{6}{5}$ Ω

4. A simple equivalent circuit of the 2 terminal network shown in fig. P1.4.4 is

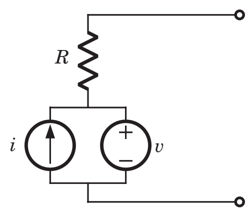
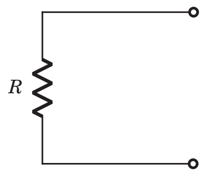
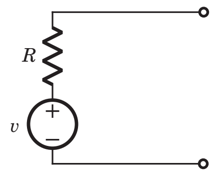


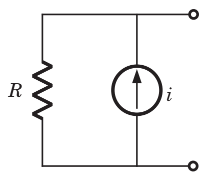
Fig. P.1.4.4



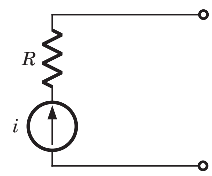
(A)



(B)



(C)



(D)

5. i_N , R_N = ?

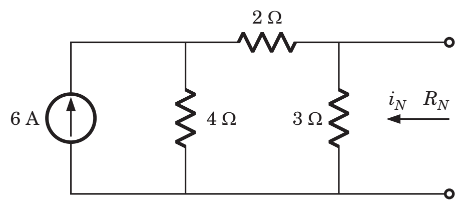


Fig. P.1.4.5

(A) 4 A, 3 Ω (B) 2 A, 6 Ω

(C) 2 A, 9 Ω (D) 4 A, 2 Ω

6. v_{TH} , R_{TH} = ?

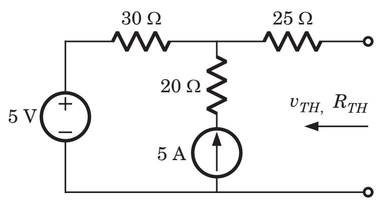


Fig. P.1.4.6

(A) –100 V, 75 Ω (B) 155 V, 55 Ω

(C) 155 V, 37 Ω (D) 145 V, 75 Ω

7. R_{TH} = ?

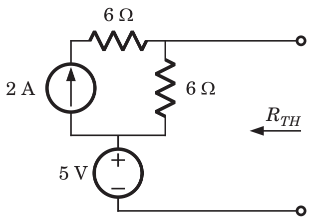


Fig. P.1.4.7

(A) 3 Ω (B) 12 Ω

(C) 6 Ω (D) ∞

8. The Thevenin impedance across the terminals ab of the network shown in fig. P.1.4.8 is

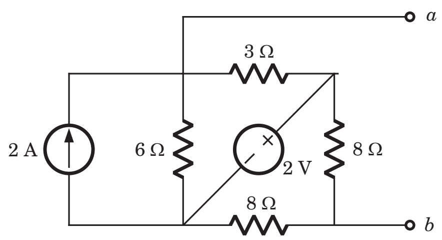


Fig. P.1.4.8

(A) 2 Ω (B) 6 Ω

(C) 6.16 Ω (D) $\frac{4}{3}$ Ω

9. For In the the circuit shown in fig. P.1.4.9 a network and its Thevenin and Norton equivalent are given

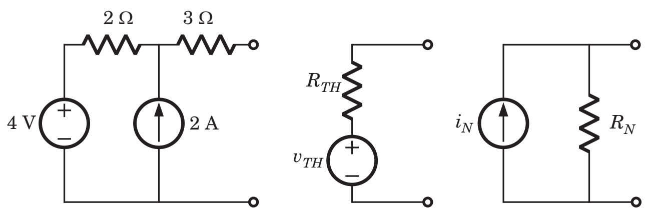


Fig. P.1.4.9

The value of the parameter are

	v_{TH}	R_{TH}	i_N	R_N
(A)	4 V	2 Ω	2 A	2 Ω
(B)	4 V	2 Ω	2 A	3 Ω
(C)	8 V	1.2 Ω	$\frac{30}{3}$ A	1.2 Ω
(D)	8 V	5 Ω	$\frac{8}{5}$ A	5 Ω

10. v_1 = ?

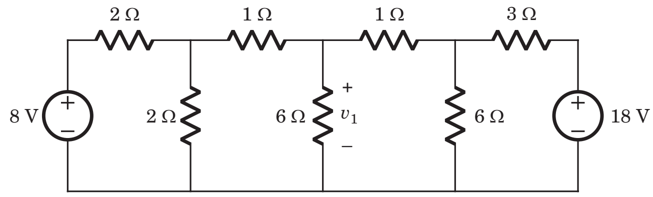


Fig. P.1.4.10

(A) 6 V (B) 7 V

(C) 8 V (D) 10 V

11. i_1 = ?

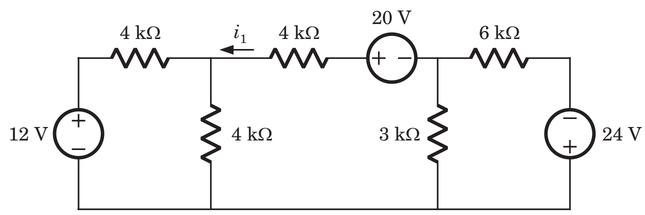


Fig. P.1.4.11

(A) 3 A (B) 0.75 mA

(C) 2 mA (D) 1.75 mA

Statement for Q.12–13:

A circuit is given in fig. P.1.4.12–13. Find the Thevenin equivalent as given in question..

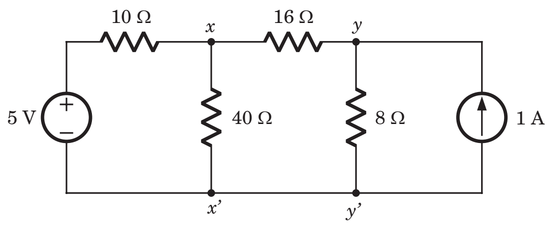


Fig. P.1.4.12–13

12. As viewed from terminal x and x' is

(A) 8 V, 6 Ω (B) 5 V, 6 Ω

(C) 5 V, 32 Ω (D) 8 V, 32 Ω

13. As viewed from terminal y and y' is

(A) 8 V, 32 Ω (B) 4 V, 32 Ω

(C) 5 V, 6 Ω (D) 7 V, 6 Ω

14. A practical DC current source provide 20 kW to a 50 Ω load and 20 kW to a 200 Ω load. The maximum power, that can drawn from it, is

(A) 22.5 kW (B) 45 kW

(C) 30.3 kW (D) 40 kW

Statement for Q.15–16:

In the circuit of fig. P.1.4.15–16 when $R = 0\ \Omega$, the current i_R equals 10 A.

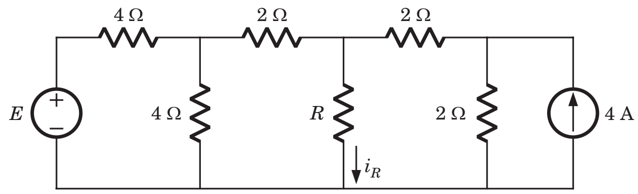


Fig. P.1.4.15–16.

15. The value of R, for which it absorbs maximum power, is

(A) 4 Ω (B) 3 Ω

(C) 2 Ω (D) None of the above

16. The maximum power will be

(A) 50 W (B) 100 W

(C) 200 W (D) value of E is required

17. Consider a 24 V battery of internal resistance $r = 4\ \Omega$ connected to a variable resistance R_L. The rate of heat dissipated in the resistor is maximum when the current drawn from the battery is i. The current drawn form the battery will be $i/2$ when R_L is equal to

(A) 2 Ω (B) 4 Ω

(C) 8 Ω (D) 12 Ω

18. i_N, $R_N = ?$

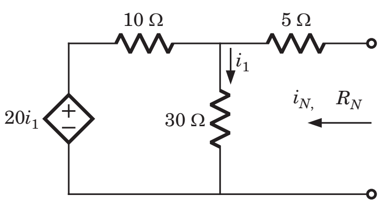


Fig. P.1.4.18

(A) 2 A, 20 Ω (B) 2 A, –20 Ω

(C) 0 A, 20 Ω (D) 0 A, –20 Ω

19. v_{TH}, $R_{TH} = ?$

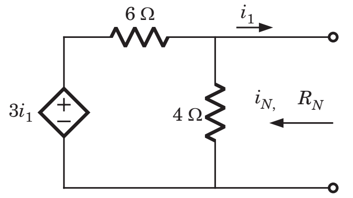


Fig. P1.4.19

(A) 0 Ω (B) 1.2 Ω

(C) 2.4 Ω (D) 3.6 Ω

20. v_{TH}, $R_{TH} = ?$

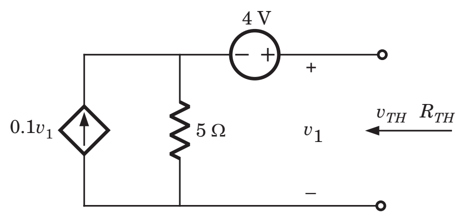


Fig. P.1.4.20

(A) 8 V, 5 Ω (B) 8 V, 10 Ω

(C) 4 V, 5 Ω (D) 4 V, 10 Ω

21. $R_{TH} = ?$

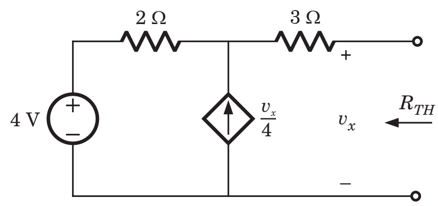


Fig. P.1.4.21

(A) 3 Ω (B) 1.2 Ω

(C) 5 Ω (D) 10 Ω

22. In the circuit shown in fig. P.1.4.22 the effective resistance faced by the voltage source is

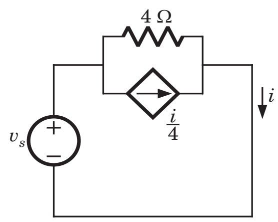


Fig. P.1.4.22

(A) 4 Ω (B) 3 Ω

(C) 2 Ω (D) 1 Ω

23. In the circuit of fig. P1.4.23 the value of R_{TH} at terminal ab is

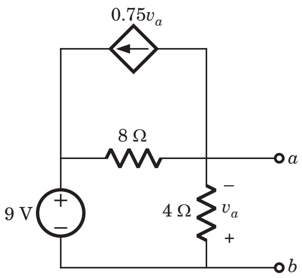


Fig. P.1.4.23

(A) –3 Ω (B) $\frac{9}{8}$ Ω

(C) $-\frac{8}{3}$ Ω (D) None of the above

24. R_{TH} = ?

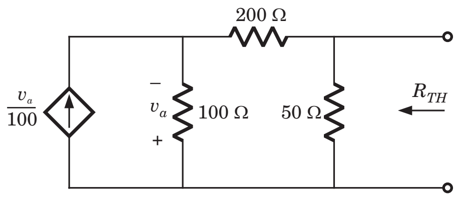


Fig. P.1.4.24

(A) ∞ (B) 0

(C) $\frac{3}{125}$ Ω (D) $\frac{125}{3}$ Ω

25. In the circuit of fig. P.1.4.25, the R_L will absorb maximum power if R_L is equal to

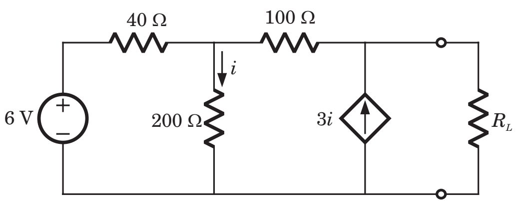


Fig. P.1.4.25

(A) $\frac{400}{3}$ Ω (B) $\frac{2}{9}$ kΩ

(C) $\frac{800}{3}$ Ω (D) $\frac{4}{9}$ kΩ

Statement for Q.26–27:

In the circuit shown in fig. P1.4.26–27 the maximum power transfer condition is met for the load R_L .

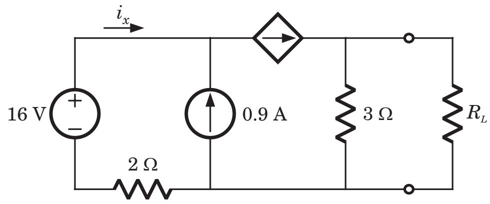


Fig. P.1.4.26–27

26. The value of R_L will be

(A) 2 Ω (B) 3 Ω

(C) 1 Ω (D) None of the above

27. The maximum power is

(A) 0.75 W (B) 1.5 W

(C) 2.25 W (D) 1.125 W

28. R_{TH} = ?

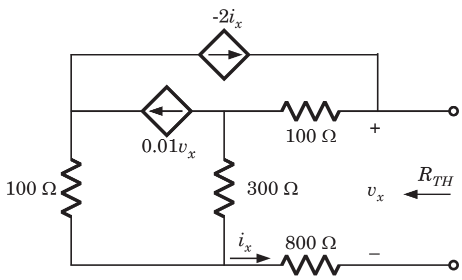


Fig. P.1.4.28

(A) 100 Ω (B) 136.4 Ω

(C) 200 Ω (D) 272.8 Ω

29. Consider the circuits shown in fig. P.1.4.29

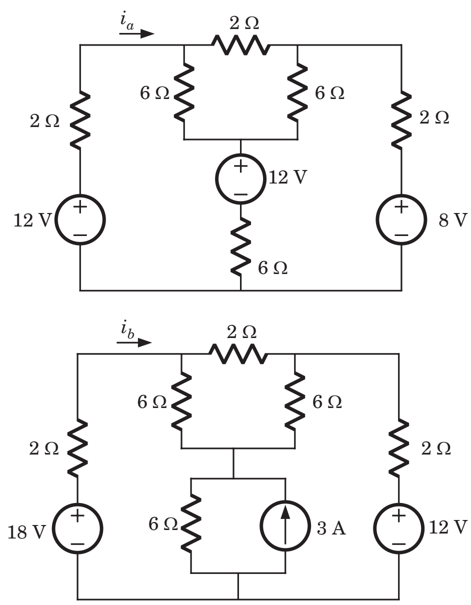


Fig. P.1.4.29a & b

The relation between i_a and i_b is

(A) $i_b = i_a + 6$ (B) $i_b = i_a + 2$

(C) $i_b = 1.5 i_a$ (D) $i_b = i_a$

30. $R_{eq} = ?$

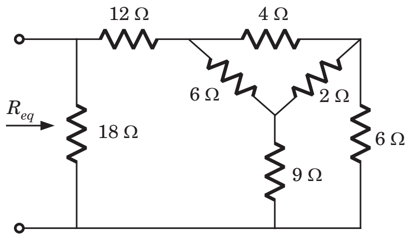


Fig. P.1.4.30

(A) 18 Ω (B) $\frac{72}{13}$ Ω

(C) $\frac{36}{13}$ Ω (D) 9 Ω

31. In the lattice network the value of R_L for the maximum power transfer to it is

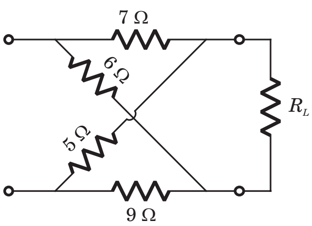


Fig. P.1.4.31

(A) 6.67 Ω (B) 9 Ω

(C) 6.52 Ω (D) 8 Ω

Statement for Q.32–33:

A circuit is shown in fig. P.1.4.32–33.

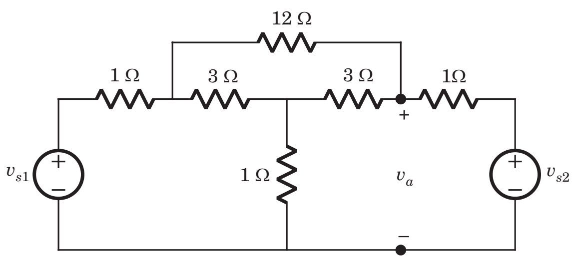


Fig. P.1.4.32–33

32. If $v_{s1} = v_{s2} = 6$ V then the value of v_a is

(A) 3 V (B) 4 V

(C) 6 V (D) 5 V

33. If $v_{s1} = 6$ V and $v_{s2} = -6$ V then the value of v_a is

(A) 4 V (B) –4 V

(C) 6 V (D) –6 V

34. A network N feeds a resistance R as shown in fig. P1.4.34. Let the power consumed by R be P. If an identical network is added as shown in figure, the power consumed by R will be

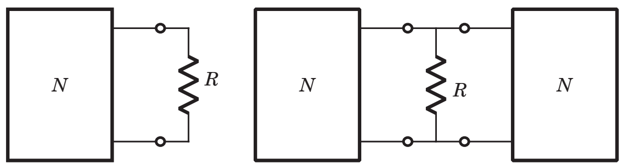


Fig. P.1.4.34

(A) equal to P (B) less than P

(C) between P and $4P$ (D) more than $4P$

35. A certain network consists of a large number of ideal linear resistors, one of which is R and two constant ideal source. The power consumed by R is P_1 when only the first source is active, and P_2 when only the second source is active. If both sources are active simultaneously, then the power consumed by R is

(A) $P_1 \pm P_2$ (B) $\sqrt{P_1} \pm \sqrt{P_2}$

(C) $(\sqrt{P_1} \pm \sqrt{P_2})^2$ (D) $(P_1 \pm P_2)^2$

36. A battery has a short-circuit current of 30 A and an open circuit voltage of 24 V. If the battery is connected to an electric bulb of resistance 2Ω, the power dissipated by the bulb is

(A) 80 W (B) 1800 W

(C) 112.5 W (D) 228 W

37. The following results were obtained from measurements taken between the two terminal of a resistive network

Terminal voltage	12 V	0 V
Terminal current	0 A	1.5 A

The Thevenin resistance of the network is

(A) 16 Ω (B) 8 Ω

(C) 0 (D) ∞

38. A DC voltmeter with a sensitivity of 20 kΩ/V is used to find the Thevenin equivalent of a linear network. Reading on two scales are as follows

(a) 0 – 10 V scale : 4 V

(b) 0 –15 V scale : 5 V

The Thevenin voltage and the Thevenin resistance of the network is

(A) $\frac{16}{3}$ V, $\frac{1}{15}$ MΩ (B) $\frac{32}{3}$ V, $\frac{200}{3}$ kΩ

(C) 18 V, $\frac{2}{15}$ MΩ (D) 36 V, $\frac{200}{3}$ kΩ

39. Consider the network shown in fig. P.1.4.39.

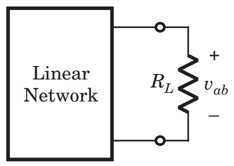


Fig. P.1.4.39

The power absorbed by load resistance R_L is shown in table :

R_L	10 kΩ	30 kΩ
P	3.6 MW	4.8 MW

The value of R_L , that would absorb maximum power, is

(A) 60 kΩ (B) 100 Ω

(C) 300 Ω (D) 30 kΩ

40. Measurement made on terminal ab of a circuit of fig.P.1.4.40 yield the current-voltage characteristics shown in fig. P.1.4.40. The Thevenin resistance is

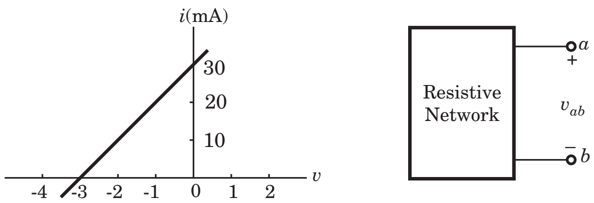


Fig. P.1.4.40

(A) 300 Ω (B) –300 Ω

(C) 100 Ω (D) –100 Ω

****

Solutions

1. (B) $v_{TH} = \frac{(6)(6)}{3+6} = 4$ V, $R_{TH} = (3 \,||\, 6) + 2 = 4\,\Omega$

2. (A)

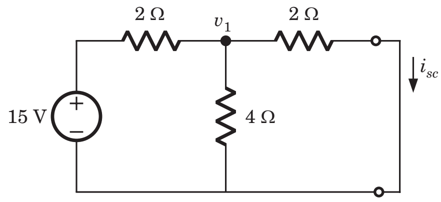


Fig. S.1.4.2

$R_N = 2 \,||\, 4 + 2 = \frac{10}{3}\ \Omega$, $v_1 = \frac{\frac{15}{2}}{\frac{1}{2}+\frac{1}{2}+\frac{1}{4}} = 6\,\Omega$

$i_{sc} = i_N = \frac{v_1}{2} = 3$ A

3. (C) $v_{TH} = \frac{(2)(3)(1)}{3+3} = 1$ V, $R_{TH} = 1 \,||\, 5 = \frac{5}{6}\,\Omega$

4. (B) After killing all source equivalent resistance is R

Open circuit voltage $= v_1$

5. (D) $i_{sc} = \frac{6 \times 4}{4+2} = 4 \text{ A} = i_N$, $R_N = 6 \,||\, 3 = 2\,\Omega$

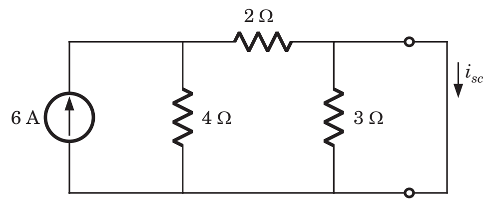


Fig. S1.4.5

6. (B) $R_{TH} = 30 + 25 = 55\,\Omega$, $v_{TH} = 5 + 5 \times 30 = 155$ V

7. (C) After killing the source, $R_{TH} = 6\,\Omega$

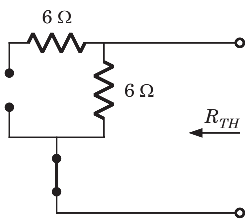


Fig. S.1.4.7

8. (B) After killing all source, $R_{TH} = 3 \,||\, 6 + 8 \,||\, 8 = 6\ \Omega$

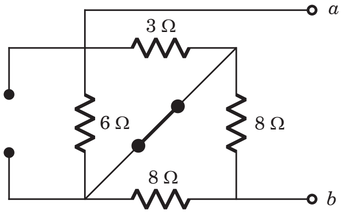


Fig. S1.4.8

9. (D) $v_{oc} = 2 \times 2 + 4 = 8\ \text{V} = v_{TH}$

$R_{TH} = 2 + 3 = 5\ \Omega = R_N, \quad i_N = \dfrac{v_{TH}}{R_{TH}} = \dfrac{8}{5}\ \text{A}$

10. (A) By changing the LHS and RHS in Thevenin equivalent

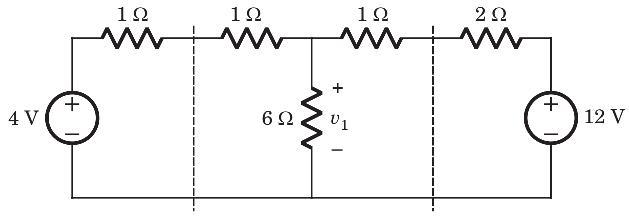


Fig. S1.4.10

$$v_1 = \frac{\frac{4}{1+1} + \frac{12}{1+2}}{\frac{1}{1+1} + \frac{1}{6} + \frac{1}{1+2}} = 6\ \text{V}$$

11. (B) By changing the LHS and RHS in Thevenin equivalent

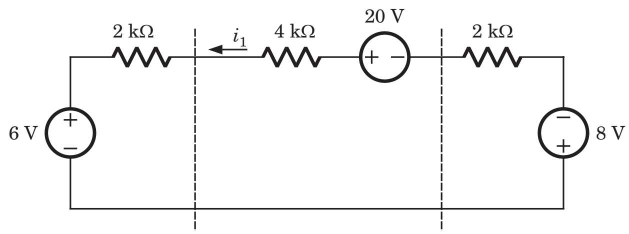


Fig. S1.4.11

$$i_1 = \frac{20 - 6 - 8}{2\text{k} + 4\text{k} + 2\text{k}} = 0.75\ \text{mA}$$

12. (B)

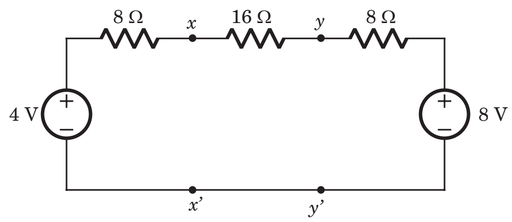


Fig. S1.4.12

If we Thevenized the left side of xx' and source transformed right side of yy'

$$v_{xx'} = v_{TH} = \frac{\frac{4}{8} + \frac{8}{24}}{\frac{1}{8} + \frac{1}{24}} = 5\ \text{V}, \qquad R_{TH} = 8 \,||\, (16 + 8) = 6\ \Omega$$

13. (D) $v_{yy'} = v_{TH} = \dfrac{\frac{4}{24} + \frac{8}{8}}{\frac{1}{24} + \frac{1}{8}} = 7\ \text{V}, R_{TH} = (8 + 16) \,||\, 8 = 6\ \Omega$

14. (A)

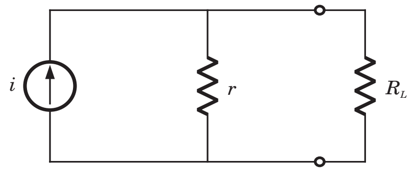


Fig. S1.4.14

$\left(\dfrac{ir}{r + 50}\right)^2 50 = 20\text{k}, \left(\dfrac{ir}{r + 200}\right)^2 200 = 20\text{k}$

$(r + 200)^2 = 4(r + 50)^2 \quad \Rightarrow \quad r = 100\ \Omega$

$i = 30\ \text{A}, \quad P_{max} = \dfrac{(30)^2 \times 100}{4} = 22.5\ \text{kW}$

15. (C) Thevenized the circuit across R, $R_{TH} = 2\ \Omega$

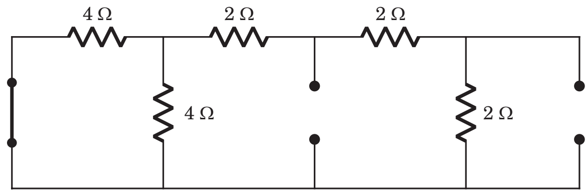


Fig. S1.4.15

16. (A) $i_{sc} = 10\ \text{A},\ R_{TH} = 2\ \Omega,\ P_{\max} = \left(\dfrac{10}{2}\right)^2 \times 2 = 50\ \text{W}$

17. (D) $R_L = r = 4\ \Omega,\ i = \dfrac{24}{4 + 4} = 3\ \text{A}$

$\dfrac{24}{R'_L + 4} = \dfrac{3}{2} \quad \Rightarrow \quad R'_L = 12\ \Omega$

18. (C) $i_N = 0$,

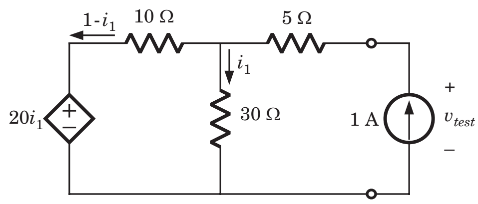


Fig. S1.4.18

$20i_1 = 30i_1 - 10(1 - i_1) \quad \Rightarrow \quad i_1 = 0.5 \text{ A}$

$v_{test} = 5 \times 1 + 30 \times 0.5 = 20 \text{ V}$

$R_N = \dfrac{v_{test}}{1} = 20\,\Omega$

19. (B) Circuit does not contains any independent source, $v_{TH} = 0$

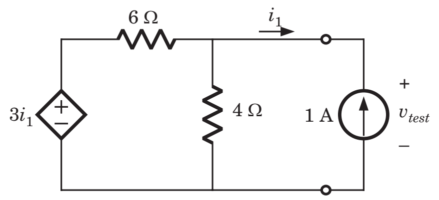


Fig. S1.4.19

Applying 1 A at terminal, $i_1 = -1$ A

$\dfrac{v_{test}}{4} + \dfrac{v_{test} - 3(-1)}{6} = 1 \quad \Rightarrow \quad v_{test} = 1.2 \text{ V}$

$R_{TH} = \dfrac{v_{test}}{1} = 1.2\,\Omega$

20. (B)

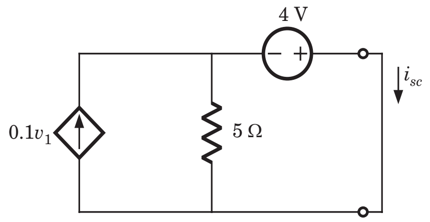


Fig. S1.4.20

$v_1 = 4 + 5 \times 0.1v_1 \quad \Rightarrow \quad v_1 = 8 \text{ V}$

$v_1 = v_{oc} = v_{TH}$

For i_{sc} , $v_1 = 0$

$i_{sc} = \dfrac{4}{5}$ A, $R_{TH} = \dfrac{v_{oc}}{i_{sc}} = 10\,\Omega$

21. (D) $v_x = 2\dfrac{v_x}{4} + 4 \quad \Rightarrow \quad v_x = 8 \text{ V} = v_{oc}$

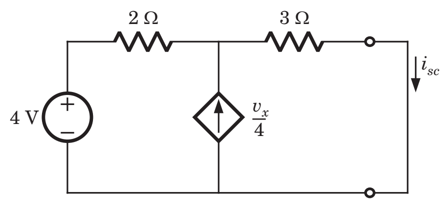


Fig. S1.4.21

If terminal is short circuited, $v_x = 0$

$i_{sc} = \dfrac{4}{2+3} = 0.8$ A, $R_{TH} = \dfrac{v_{oc}}{i_{sc}} = \dfrac{8}{0.8} = 10\,\Omega$

22. (B) $v_s = 4 \times \dfrac{3i}{4} \quad \Rightarrow \quad \dfrac{v_s}{i} = 3\,\Omega$

23. (C) $v_{oc} = v_{ab} = -v_a$, $\quad \dfrac{v_{oc}}{4} + \dfrac{v_{oc} - 9}{8} + 0.75v_a = 0$

$2v_{oc} + v_{oc} - 9 + 6(-v_{oc}) = 0$, $v_{oc} = -3$ V

If terminal ab is short circuited, $v_a = 0$

$i_{sc} = \dfrac{9}{8}$ A and $R_{TH} = \dfrac{v_{oc}}{i_{sc}} = \dfrac{-3}{9/8} = \dfrac{-8}{3}\,\Omega$

24. (D) Using source transform

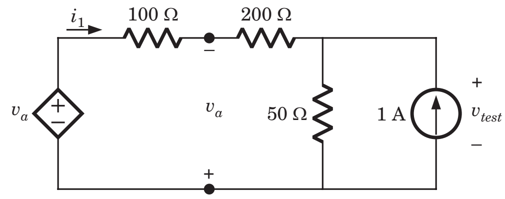


Fig. S1.4.24

$v_a = 100i_1 + 200i_1 + 50(i_1 + 1)$

$v_a = 100i_1 - v_a \quad \Rightarrow \quad v_a = 50i_1$

$50i_1 = 300i_1 + 50i_1 + 50 \quad \Rightarrow \quad i_1 = -\dfrac{1}{6}$ A

$v_{test} = 50\left(1 - \dfrac{1}{6}\right) = \dfrac{125}{3}\,\Omega$

25. (C)

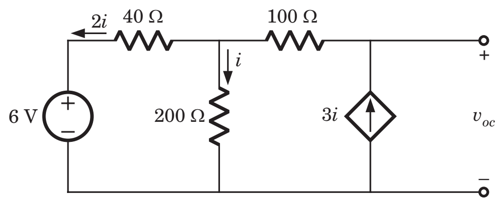


Fig. S1.4.25a

$6 = 200i - 40 \times 2i \quad \Rightarrow \quad i = \dfrac{1}{20}$ A

$v_{oc} = 100 \times 3i + 200 \times i = 25$ V

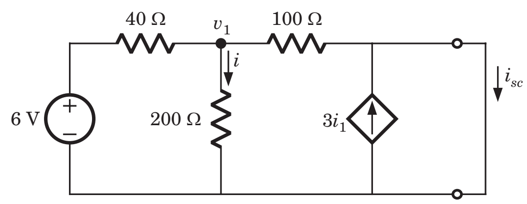


Fig. S1.4.25b

$v_1 = \dfrac{\frac{6}{40}}{\frac{1}{40} + \frac{1}{200} + \frac{1}{100}} = \dfrac{15}{4}$ V, $i = \dfrac{15}{4 \times 200} = \dfrac{3}{160}$ A

$$i_{sc} = \frac{16}{4 \times 100} + \frac{3 \times 3}{160} = \frac{3}{32}\ \text{A}, \quad R_{TH} = \frac{v_{oc}}{i_{sc}} = \frac{25}{3/32} = \frac{800}{3}\ \Omega$$

26. (B) $i_x + 0.9 = 10i_x \quad \Rightarrow \quad i_x = 0.1$ A

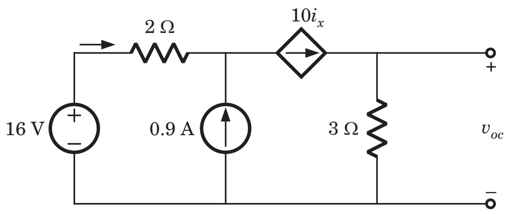


Fig. S1.4.26

$v_{oc} = 3 \times 10i_x = 30i_x \quad \Rightarrow \quad v_{oc} = 3$ V

$i_{sc} = 10i_x = 1$ A, $R_{TH} = \frac{3}{1} = 3\,\Omega$

27. (A) $v_{TH} = v_{oc} = 3$ V, $R_L = 3\,\Omega$, $P_{max} = \frac{3^2}{4 \times 3} = 0.75$ W

28. (A) $i_x = 1$ A , $v_x = v_{test}$

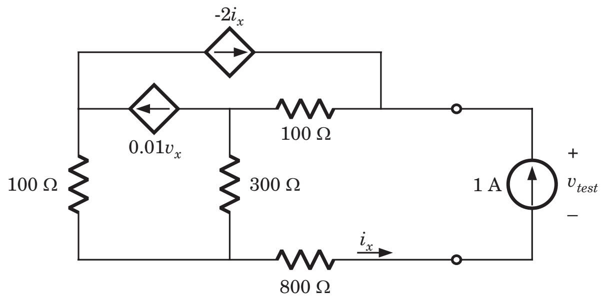


Fig. S1.4.28

$v_{test} = 100\,(1 - 2i_x) + 300\,(1 - 2i_x - 0.01v_x) + 800$

$\Rightarrow \quad v_{test} = 1200 - 800i_x - 3v_{test}$

$4v_{test} = 1200 - 800 = 400 \quad \Rightarrow \quad v_{test} = 100$ V

$R_{TH} = \frac{v_{test}}{1} = 100\,\Omega$

29. (C) In circuit (b) transforming the 3 A source in to 18 V source all source are 1.5 times of that in circuit (a). Hence $i_b = 1.5i_a$.

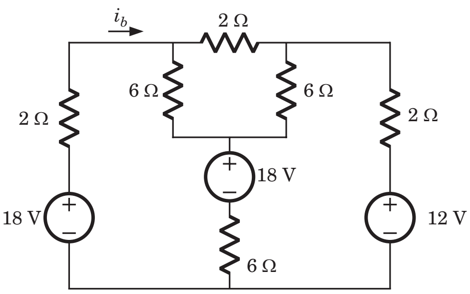


Fig. S1.4.29

30. (D) Changing the Δ to Y

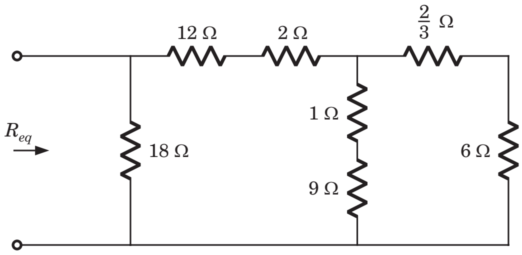


Fig. S1.4.30

$$R_{eq} = 18 \,||\left(14 + 10 \,||\left(6 + \frac{2}{3}\right)\right) = 18 \,||\,(14 + 4) = 9\,\Omega$$

31. (C) $R_{TH} = 7\,||\,5 + 6\,||\,9 = 6.52\,\Omega$

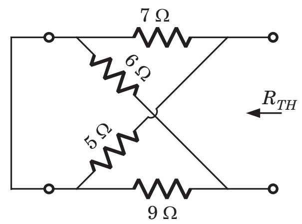


Fig. S1.4.31

For maximum power transfer $R_L = R_{TH} = 6.52\,\Omega$

32. (D) The given circuit has mirror symmetry. It is modified and redrawn as shown in fig. S.1.4.32a.

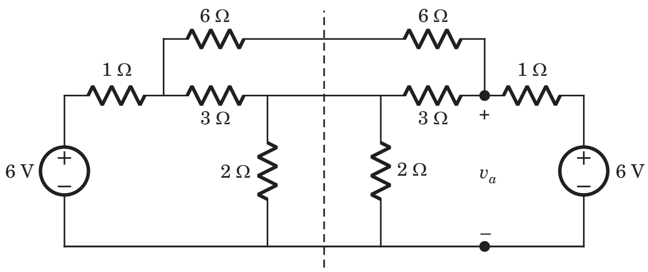


Fig. S.1.4.32a

Now in this circuit all straight-through connection have been cut as shown in fig. S1.4.32b

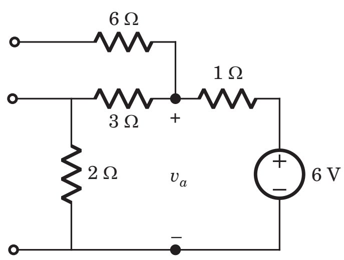


Fig. S.1.4.32b

$$v_a = \frac{6 \times (2 + 3)}{2 + 3 + 1} = 5\ \text{V}$$

33. (B) Since both source have opposite polarity, hence short circuit the all straight-through connection as shown in fig. S.1.4.33

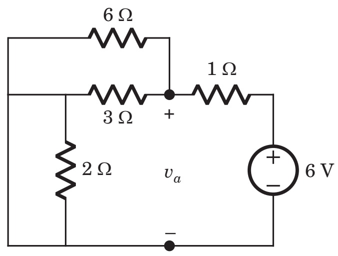


Fig. S1.4.33

$$v_a = -\frac{6 \times (6 \,||\, 3)}{2+1} = -4 \text{ V}$$

34. (C) Let Thevenin equivalent of both network

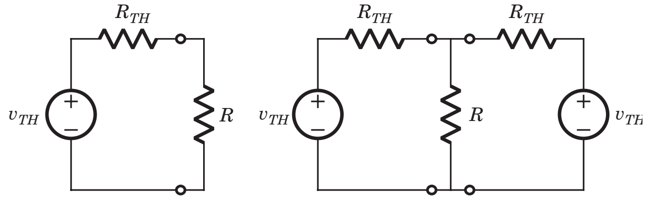


Fig. S1.4.34

$$P = \left(\frac{V_{TH}}{R_{TH}+R}\right)^2 R$$

$$P' = \left(\frac{V_{TH}}{R + \frac{R_{TH}}{2}}\right)^2 R = 4\left(\frac{V_{TH}}{2R + R_{TH}}\right)^2 R$$

Thus $P < P' < 4P$

35. (C) $i_1 = \sqrt{\frac{P_1}{R}}$ and $i_2 = \sqrt{\frac{P_2}{R}}$

using superposition $i = i_1 + i_2 = \sqrt{\frac{P_1}{R}} \pm \sqrt{\frac{P_2}{R}}$

$i^2 R = (\sqrt{P_1} \pm \sqrt{P_2})^2$

36. (C) $r = \frac{v_{oc}}{i_{sc}} = 1.2\ \Omega$

$$P = \frac{24^2}{(1.2+2)^2} \times 2 = 112.5 \text{ W}$$

37. (B) $R_{TH} = \frac{v_{oc}}{i_{sc}} = \frac{12}{1.5} = 8\ \Omega$

38. (A) Let $\frac{1}{\text{sensitivity}} = \frac{1}{20\text{k}} = 50\ \mu\text{A}$

For 0 –10 V scale $R_m = 10 \times 20\text{k} = 200\text{ k}\Omega$

For 0 –50 V scale $R_m = 50 \times 20\text{k} = 1\text{ M}\Omega$

For 4 V reading $i = \frac{4}{10} \times 50 = 20\ \mu\text{A}$

$$v_{TH} = 20\mu R_{TH} + 20\mu \times 200\text{k} = 4 + 20\mu R_{TH} \quad \text{...(i)}$$

For 5 V reading $i = \frac{5}{50} \times 50\mu = 5\ \mu\text{A}$

$$v_{TH} = 5\mu \times R_{TH} + 5\mu \times 1\text{M} = 5 + 5\mu R_{TH} \quad \text{...(ii)}$$

Solving (i) and (ii)

$$v_{TH} = \frac{16}{3}\text{ V},\ R_{TH} = \frac{200}{3}\text{ k}\Omega$$

39. (D) $v_{10\text{k}} = \sqrt{10\text{k} \times 3.6\text{m}} = 6$

$v_{30\text{k}} = \sqrt{30\text{k} \times 4.8\text{m}} = 12\text{ V}$

$$6 = \frac{10}{10 + R_{TH}} v_{TH} \quad \Rightarrow \quad 10 v_{TH} = 6 R_{TH} + 60$$

$$12 = \frac{30\ v_{TH}}{30 + R_{TH}} \quad \Rightarrow \quad 5 v_{TH} = 2 R_{TH} + 60$$

$R_{TH} = 30\text{ k}\Omega$

40. (D) At $v = 0$, $i_{sc} = 30$ mA

At $i = 0$, $v_{oc} = -3$ V

$$R_{TH} = \frac{v_{oc}}{i_{sc}} = \frac{-3}{30\text{m}} = -100\ \Omega$$

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